

# Atomic Analogy of Poverty

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**Abstract:** An analogy between the model of an atom and poverty of an individual in a poverty field is presented to construe that poverty levels are quantized in similar notions as in the models of an atom. This analogy provides a rational explanation of the observed phenomena in society in part as well as it can be used to predict future observations. Concepts proposed in this paper may lead to a framework to quantify poverty, absolute or relative, and suggest enhanced collaboration between moral science and natural science to study poverty dynamics.

**One Sentence Summary:** The Poverty field has been conceptualized, and the field is augmented with an analogy to recommend a new way to measure poverty while explaining some events in human society.

**Main Text:** \_\_\_\_\_

## Introduction

To begin with our classical heritage, Adam Smith (<sup>1</sup>), in the eighteen century, perceived poverty as an insufficient supply of those things which are requisite for an individual to maintain himself and those dependent upon him in health and vigor. Rowntree (<sup>2</sup>) segregated poverty to primary and secondary. J. B. Hurry defined poverty as the condition of a person who lacks the necessities for subsistence and efficiency (<sup>3</sup>). Efficiency as meant by Hurry then could be equivalent to individual 'capabilities' by Amartya Sen – one refers to output while the others may refer to the path (short term and/or long term) and outcome together. Unless one can utilize capabilities well enough, the outcome cannot be as efficient.

Between two common classes of poverty measurement, the ad hoc measures lack theoretical derivation while the axiomatic measures are based explicitly on desirable properties that a poverty index should respect-axioms developed by Sen (<sup>4</sup>) in 1976. In addition, a third set of measures, which derived directly from the stochastic dominance literature, is based on the dominance of either Lorenz Curves or Generalized Lorenz Curves.

Lester Thurow <sup>(5)</sup> made an attempt to explain incidence of poverty in terms of a regression equation of multiple variables of economy. The analysis of poverty has traditionally been atheoretical <sup>(6)</sup>, philosophical, focusing mainly on statistical approaches such as regression of multi-variables, principal component analysis or time series decompositions of poverty trends etc. Ruth Lister <sup>(7)</sup> presented a difference of lens between the North and the South to look at poverty, however an integrated approach that can combine not only the North-South but also the East-West together can bolster the poverty analysis. It is always better that such discussions be part of the solution rather than the problem to avoid academic debate producing more heat than light.

Where does poverty come from and how it is perpetuated? Unless such questions become part of scientific discourse, poverty will continue to be constructed as a cause rather than a product, and its resolution will remain elusive <sup>(8)</sup>. President Obama, with reference to America's first-ever Climate Action Plan to use more clean energy, opined at Young Southeast Asian Leaders Initiative (2014) Town Hall that "We can't condemn future generations to a planet that is beyond fixing." Nobody chooses poverty by will nor can it be sin (or curse) given to humanity. Generational poverty, a child born in poverty cannot get out of its vicious cycle in his life, cannot be more than a structural problem in itself <sup>(9)</sup>. Maya Angelou (and her creations left for humanity), tirelessly making an attempt to teach mankind that we are each wonderfully made, intricately woven and put on this earth for purpose for a greater than we could ever imagine. Generational poverty should not continue even *In The Ghetto*, a song by Elvis Presley. Such conditions not only hinder some of etiquettes of democracy, such as equal opportunity by birth, but also legislate an individual out of the economy. Together as member of the human race, we must respect birth right of the coming generation.

## Poverty Model

### 1 Concepts

We postulate that poverty field is a quasi-conservative field, defined as a field for which rate of change of total energy is a monotonic function of time. Analogous to other vector fields, a poverty field influences an individual of a society. We argue that poverty levels are quantized <sup>(10)</sup> in similar notion as in established models of an atom, Bohr's theory of the hydrogen atom <sup>(11)</sup> and Schrödinger equation <sup>(12)</sup>.

### 2 Quantifications

Consider an individual with strength  $I$  constrained in society of poverty strength,  $S$ . Poverty exerts a social force on the individual equal to  $SI/r^2$  (In natural unit), where  $r$  is the trust

$$\text{Social Force on individual} = SI/r^2;$$

$$\text{Poverty Intensity} = S/r^2;$$

$$\text{Potential} = -S/r;$$

$$\text{Potential Energy} = (-S/r)*I \rightarrow \text{Capabilities à la Sen} \rightarrow 0 \text{ as } r \rightarrow \infty.$$

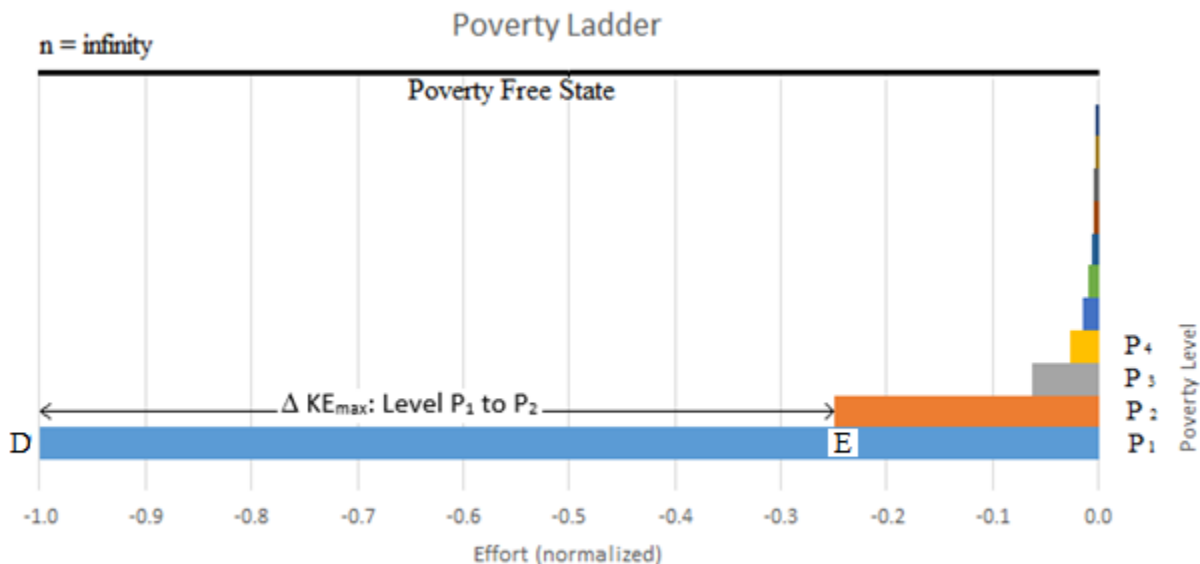
$$\text{Kinetic Energy} = - (1/2) \text{ Potential Energy} = S I/r$$

vector which an individual can maintain with the society in equilibrium. The inverse square law holds true to poverty field as well, and together with concepts above provide rational explanation of some observed phenomena in society and help frame poverty dynamics.

Based on Bohr's Theory of H-atom, Total Energy (TE) = Kinetic Energy (KE) + Potential Energy (PE) =  $-P_0/n^2$ ; where n is a positive integer representing poverty level. At extreme poverty  $n = 1$ ,  $TE = -P_0$ . The time evolution of such association can be formulated through a modification of the Schrödinger and Hamilton's equations that incorporates the postulate about the poverty field. This analogy can be expanded to develop a framework to answer some of the questions related to poverty dynamics such as multiple spells of poverty, and how long will it take for an individual to climb out of the levels of poverty (<sup>13</sup>)? In an interesting book (<sup>14</sup>) the author Charles Karelis attempts to explain poverty dynamics on the foundation of marginalism using theory 'Law of Diminishing Marginal Utility of Consumption' together with an adage by Austin Frum as 'Comfort the afflicted and afflict the comfortable'. With reasonably valid assumptions about complex social forces around us, the exact science, together with perturbation theory, should still be able to define an activity in the social domain, at reasonable scales.

### Poverty Levels

The threshold below which a degradation to lower poverty level results to dissatisfaction (analogous to radiation,  $h\nu$  - where h is Planck's constant and  $\nu$  is frequency in Hz) can be called Poverty Free State (PFS) as indicated in Fig.1. This could be the absolute poverty threshold where – at least there will not be statistically significant generational poverty. Below PFS, we start growing pockets of very dissatisfied people with cynicism which may initiate into riots that can easily grow into a full fledged social unrest such as civil war – if not addressed properly in timely manner. This analogy can serve as a casual explanation of civil war such as Nepalese civil war (<sup>15</sup>) that started back in 1996.



**Fig. 1.** Poverty Levels and Poverty Ladder

Change of kinetic energy of an individual help him move left to right but may not move up on the poverty ladder which will require change in potential energy, corroborates also with Sen:

“capabilities” should be seen as absolute. Extreme poverty, borrowing words again from Sen, can be seen as the ability to survive rather than succumb to premature mortality, may start at E. Primary and secondary poverty as cited in the opening paragraph, by Rowntree, could be KE and PE or vice versa.

Citing East-Asian case (<sup>16</sup>), Ha-Joon Chang thought that poverty can only be solved by development of productive capabilities of society and individual together; this upholds the analogy. Dependency theory suggests international system prevents some countries from development. External aid, unless designed very well, does provide KE that only can alter absolute poverty at a given level (<sup>17</sup>). Such an aid may not help move an individual up the poverty ladder but only degenerate capabilities of both the society and the individual. However, aids (like Red Cross® always have a role on a special kind of poverty such as humanitarian crisis as well as during extreme natural events like earthquakes, famine etc.

### **Absolute vs Relative Poverty**

We propose to define absolute poverty with reference to Poverty Free State (PFS) where  $n = \infty$ , the top of the poverty ladder. Absolute zero poverty must give an extent of an issue together human race aspire to achieve. A relative deprivation approach to poverty, by Townsend bases that relative position of a region (or the political boundary) on the poverty ladder would still be independent of income. Relative poverty lines are rarely used in developing countries but are frequent in so called developed countries where emphasis is on social bond rather than on meeting daily basic needs. The World Bank working definition (<sup>18</sup>) of absolute poverty line as \$1.25-per-day (that we prefer to call a proxy of absolute poverty, that was agreed on UN Millennium Forum, 2000, for a different reason), is a relative poverty measure across many poor and middle-income countries over time. Being a relative measure it has local political implication hence can't be without any connotations. Nonetheless it is still a good relative measure to have a feel of one of the challenges humanity is facing and devise macro level short term international policy. However, we all know it is important for temperature to be in Kelvin for different laws of nature, although Centigrade relates to Kelvin as  $K = ^\circ C + 273.15$ , on the same scale but with different origin.

As our universe's expansion is accelerating, so is probably the poverty field such that  $Po = f(\text{time, space})$  based on the postulate above. Economic growth of the world over time as the neoclassical economics and several management theories assert, has also increased  $Po$ , because  $TE = Po/n^2$  (in magnitude) increasing poverty levels in parallel. This postulate also backs up Townsend main thesis that both poverty and subsistence are relative concepts (<sup>19</sup>) because the poverty field be expanding too. It could be one reason to explain why globalization may not have reduced poverty but only have improved living conditions of many. A corollary of the postulate, hence, will be that economic growth always has a toll on poverty. The World Bank president Jim Yong Kim has publicly admitted economic growth is "not enough" to end global poverty. Appending poverty reduction agenda to secure financial stability (and growth), hence, cannot be more than an inoculation. Such a vision/agenda may not be addressing much the shared prosperity together we strive for. Mr. Wendal from Arrested Development suggests learning from the poor on non-materialistic lifestyles. The newly elected Indian Prime Minister Narendra Modi offered that Pakistan be allies in the war on poverty, could also be a political point, what exactly is required in the region and world around us as a whole. Adam Smith then predicted,

"No society can surely be flourishing and happy of which by far the greater part of the numbers are poor and miserable."

### **Vicious Circle of Poverty**

Vicious circle, according to Hurry, is the process by which a primary disorder provokes a reaction which aggravates such disorder. In the ordinary course of economic laws the reaction provoked by social disorder tends to arrest such disorder - but when vicious circle is established the usual sequences are reversed and intensify the disorder <sup>(20)</sup>. For example let's consider malnutrition. Poverty leads to malnutrition; this begets debility which causes diminished earning capacity, and this accentuates the poverty. In addition to physical damage poverty may cause, emotional toll could be even worse, which may deprive an individual of peace of mind. It has recently been established that poverty related worries impede cognitive function as well <sup>(21)</sup>.

By default the poverty field, according to this analogy, shall be vicious as total energy of an individual in poverty field is negative. Poverty fields normally have a tendency to impact an individual twice as much because  $PE = -2 KE$ . The case may be opposite in a utopian society. It can be linked to interatomic forces that can be attractive in short range and repulsive in the long range. Advanced society also helps translate individual capability, PE to KE, in a gradual process. In such a society social forces may propel an individual favorably up on the poverty ladder. It may not be possible for an individual in poverty to escape poverty field at once which demands enough KE such that TE be zero. It may be impractical to provide enough KE at once, hence space rocket uses two or more stages.

Advances in information technology (IT) are helping expand the boundary, infinity as previously thought. General sequence of IT use in the developing countries, in general, imply the following levels: learn, misuse, and use ( $PE \leftrightarrow KE$ ). IT can help increase PE, or  $PE \leftrightarrow KE$ , and eventually beneficial to the poor.

### **Social Security or Welfare Benefits**

Mollie Orshanksy, an economist of the Social Security Administration in the early 1960s, perceived the poverty threshold as the level of income that separates the poor from the not poor. With reference to a relative poverty threshold defined within a political boundary, the administration can provide enough equivalent KE (compares to benefits) so that an individual (or a family) not tumble to lower poverty level and start expressing dissatisfaction over administration (or environment). The maximum welfare (at extreme poverty  $n = 1$ ) can be equivalent to  $(\Delta KE)_{max}$ , if PFS be defined as  $n = \text{infinity}$  as in Fig. 1. However, relative poverty (or deprivation) may have its own scale, and may be with different value of n, the optimized benefit could be less than  $(\Delta KE)_{max}$ .

Welfare standards vary across US states, and no state provides benefits as generous as the official poverty thresholds <sup>(22)</sup>. It could be because program benefit levels have not been adjusted over time to take account of monotonic nature of Po over time, as entropy (analogy  $dP/f(p)$ ) does increase over the real thermodynamic processes. Some economists have suggested to revise measure or perhaps even several measures, including at least one indicator of asset poverty <sup>(23)</sup> which has been perceived as a net worth insufficient to cover minimal living expenses for three

months. Procedures for annual updates of poverty measures could include developing a correlation of Po with multiple economic indicators at a given time, as attempted by Thurow (5) followed by a forecast. An optimum benefit can be designed such that an individual does not slip down on the poverty ladder.

## **Migration and Refugee**

Migrants move primarily for economic motive, whereas refugees may have multitudes of reasons. People did move in the human history, however the movement around the world been more than ever. A large portion of people in the developing world aspire to migrate to high S society for a perceived prosperity. Social trust vector of a migrant in a new society may depend on his capabilities, say PE, and hence for those individual, changes in trust vector sometimes can outweigh the merits of S. In selective migration an administration tends to select individual with high I or high enough KE or PE in the society. Migration and refugee can be related to widening rise and rung of the poverty ladder due to economic growth and its inherent nature of toll on poverty. Whatever be the reasons for the movement, push and pull (a vector field) factors have sometimes led to social unrest.

## **Conclusion**

The atomic analogy of poverty provides a framework to conceptualize and study poverty field that can explain many observed phenomena in the society. We hope that analogy presented here will be helpful to further the understanding of poverty field such that one can estimate intervention of public policy (or welfare tool) on poverty dynamics. A follow up research could be validating the proposed model with say one of the dimensions of poverty. It simply cannot be another Antinomy of Reasons but we believe that the proposed analogy interpreting complex social dynamics demands scrutiny further from wider community to establish fundamental concepts of poverty field. This analogy also opens doors for enhanced collaboration among branches: moral science, natural science and the other sciences.

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CARD at IOE (<http://ioe.edu.np/>) may be interested to bring this paper in public domain that will be acknowledged too.

### Supplementary Materials:

Poverty field, as presented in this paper, being an interdisciplinary topic, the prospective readers of other disciplines (say social scientists) may want to peruse a lecture note by Prof. Brian J. Smith, Department of Physics at University of Oxford, on Quantum Ideas 'Chapter 3: Bohr model of hydrogen', as one of the Supplementary Materials.

Website: <http://www.physics.ox.ac.uk/Users/smithb/website/coursenotes/qi/QILectureNotes2.pdf>

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